Climate Change as a Challenge to Soil and Land Management

Rewarding Sustainable Soil- and Land Management in the Face of Climate Change

Bern, June 24. 2010

1. Introduction

The Forum SLM offers a platform for technical and professional exchange between professionals who are active in SLM. Selected inputs in form of presentations constitute the basis for discussion and exchange of experience. The topics of the Fora SLM hinge on current issues in natural resource governance, development, and poverty. The Forum also aim to bring aspects of natural resource management to the centre stage of discussion, which may not receive due attention elsewhere.

The topic of carbon sequestration in agricultural soils gains importance within the international climate change debate. The importance of soils in sequestering and emitting greenhouse gases is well accepted. However, the international discussion around mitigation is tilted towards the forest sector. The processes that influence the dynamics of various gases in the soil are complex. They are influenced to a much greater extend by land management than is the case in the forestry sector. Hence sequestration measurements are difficult and effective models are as yet not well developed.

This Forum aimed to highlight the opportunities and challenges of greenhouse gas sequestration in soils and discuss options of rewarding land users.

The first Forum on this topic took place in August 2009 and looked at historical, technical and practical aspects of soil management. This Forum was a follow up event and looked specifically at institutional and socio-economic consequences of soil and land management challenged by climate change.

This report summaries the inputs and the discussions. The full presentations are available at http://www.cde.unibe.ch/Research/FSLM_Re.asp

2. Entering into the topic

Andrea Ries (Swiss Agency for Development and Cooperation, SDC) opened the Forum and introduced its objective. She highlighted the challenge to link international mechanisms for combating climate change and the need to increase and secure agricultural production. Meeting this challenge requires a better understanding of the role of soils under the various management approaches. It also requires developing systems of monitoring soil carbon and paying those who foster carbon sequestration by way of adjusting land management techniques.

It is likely that soil management in agriculture will assume a broader prominence as a means of climate change mitigation. Investment opportunities in agriculture might improve as a result of establishing payment regimes for carbon sequestration in agricultural soils.

A major challenge for the SDC is to identify opportunities for strengthening its own work in agriculture, with a view to support the development of the sequestration potential of soils, on the one hand, and strengthening agricultural production in the fight against poverty, on the other hand.

This Forum intended to better understand the challenges that the establishment of payment schemes for carbon sequestration in agricultural soils pose.

3. Presentations

Overview

The presentations offered specific information on the current status and challenges of rewarding greenhouse gas (GHG) mitigation through agricultural soils.

Andreas Gattinger, Forschungsanstalt für Biologischen Landbau, FIBL, Switzerland

The presentation highlighted the potential of organic agriculture to increase soil organic carbon, SOC. The presentation prompted the discussion about the role of labels, for example organic agriculture, to which sustainable soil practices, which foster greenhouse gas mitigation, could be attached.

Andreas Wilkes, World Agroforestry Centre

The presentation showed one example from China where changes in the use of pasture are implemented aiming to improve the carrying capacity, for development, food security etc. and the carbon sequestration in the soil, for greenhouse gas mitigation. The presentation highlighted the challenge of establishing a baseline of soil carbon and monitoring changes therein.

Giacomo Branca, Food and Agriculture Organisation, FAO

The presentation highlighted critical aspect of carbon sequestration and food security that both have to be addressed in regimes that reward carbon sequestration in agricultural soils.

Andreas Gattinger, Forschungsanstalt für Biologischen Landbau, FIBL, Switzerland

This second presentation of FIBL showed a method, currently being tested at the institute. It measures carbon in soils under organic agriculture. It was highlighted that there exists, at present, no CDM project for carbon sequestration in agriculture. Therefore, the presentation suggested concentrating initially on ‘low hanging fruits’. That is to focus on agricultural

practices which are accepted as CDM schemes, for example biogas, fertilizer avoidance or agroforestry.

Chris Morger and Thomas Stadtmüller, Intercooperation and Helvetas, Switzerland

A combined presentation looked at past projects of both organizations in the areas of sustainable land management. It could be shown that any of these past projects did in fact carry an inherent carbon mitigation effect. Though this effect was not specifically mentioned in the project documents and was not measured, it can be assumed, given the current knowledge, that sequestration took place and CO_2 emissions in the sector, through the project were avoided.

Presentations

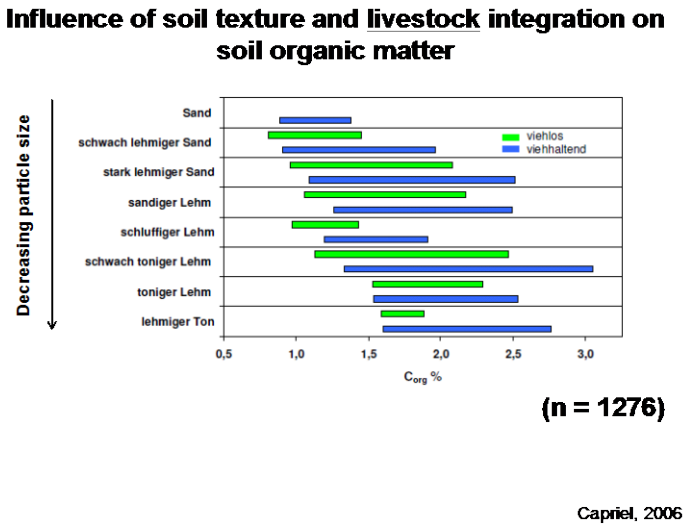
Andreas Gattinger, FIBL: Sustainable management of Soil Ecosystem Services – the Example of Organic Agriculture

The presentation explained that organic agriculture is well positioned to mitigate climate change because to the accumulation of soil organic contents. The presentation showed various experiments proving that organic agriculture can also support food security through more stable agricultural systems. While food security in conventional systems will decrease in the medium- to long term because many natural cycles are left open or are disturbed by external inputs, like fertiliser.

It was shown that agriculture, in future will be faced with a 'trilemma' because of the need to produce food, mitigate climate change and suffice energy demands.

A change in the current system of agricultural production will, therefore have considerable mitigation potential until equilibrium of the carbon metabolism in the soil is reached.

The presentation provoked a discussion on the aspect of closing cycles. It was argued that, in case organic agriculture closes for example the carbon cycle after some time, its carbon mitigation potential will thereafter reduce considerably. It was, on the other hand argued that even if cycles are closed the carbon metabolism will increase within the cycles as a result of higher atmospheric carbon presence. The system's tendency to balance carbon stocks in the atmosphere may lead to increased carbon fluxes as CO_2 is sequestered at greater intensities. Therefore, the question of closed and open cycles appeared central to the discussion.



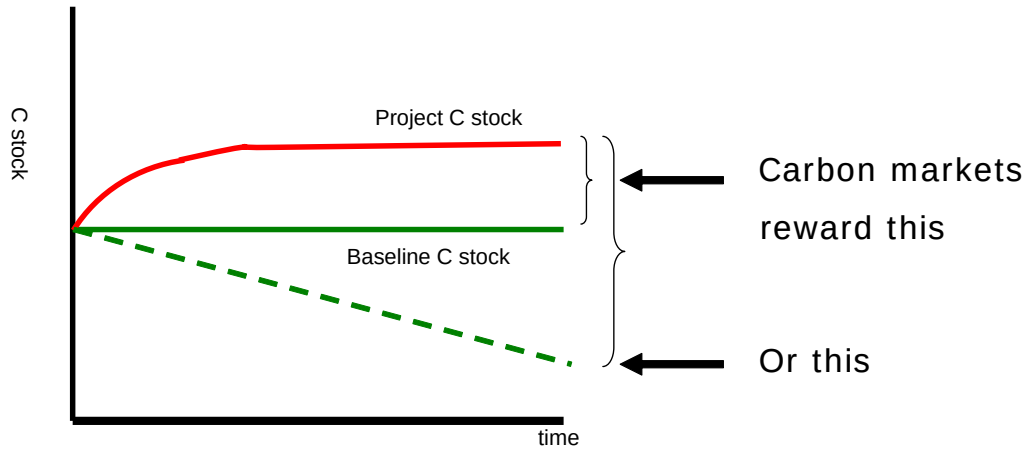
The question of the time required to build up organic material in the soil and, thereby sequester carbon, could not finally be answered. It was shown that the sequestration intensity also depended on the soil texture. Data from FIBL experiments shown during the presentation indicate that heavy clay type soils have a greater potential to build up organic carbon. This potential is further increased if livestock is part of the production cycle.

At current carbon prices the benefits of carbon payment from mitigation effort of agriculture appears low. Therefore, the incentive of land users to change productions systems may be equally low.

Contact: http://www.fibl.org/de/schweiz/standort-ch.html

Andreas Wilkes, World Agro-forestry Centre: There rivers grassland carbon sequestration project – Experiences from Project development in China. A. Wilkes, ICRAF China

A project was presented that attempts to measure changes in soil organic carbon (SOC) as a result of management changes. The carbon sequestration effect in soils can be measured or be calculated based on models but many of these models are still in the process of being developed.



The problem of additionality, that is an important element in rewarding schemes, was discussed.

The presentation informed that projects cannot establish payment systems without being able to identify additionality. An additional effect occurs when changes in land management result in increased carbon sequestration. Such effect has to be measured against a baseline. The establishment of the baseline carbon status is also difficult as it can currently not be know whether the project is confronted with a stable baseline or whether the baseline fluctuates, for example in tune with increasing soil degradation.

The project presented depends on the cooperation from pastoralist to reduce their stock as one element of changing the land use regime. It was discussed

whether farmers will reduce stocking rates, given falling incomes, the need to survive and the habit of keeping livestock for a number of other reasons not just economical reasons. The presenter argued that farmers do see the problem of resource degradation and are willing to innovate if the slump in income that goes with any innovation and investment can be covered, possibly by a financial institution or project as the one presented.

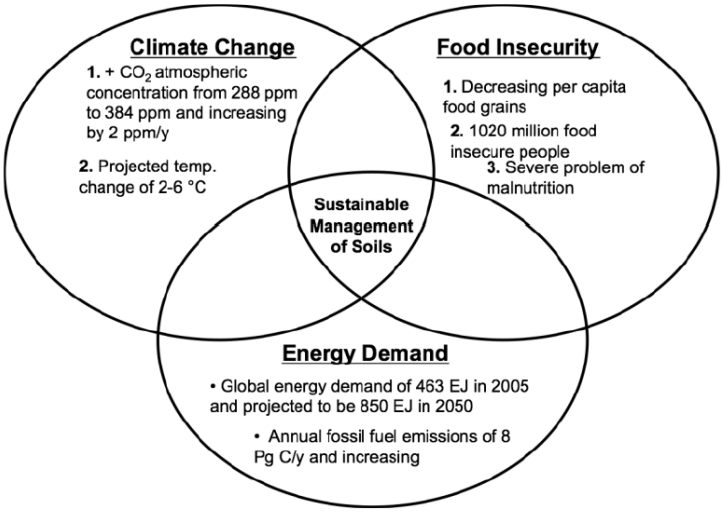
Projects like the one presented focus to establish soil carbon sequestration from agriculture in international markets. A change to more sustainable land use practices will generate, besides carbon sequestration also a number of co-benefits like: improved soil structure, soil life, improved soil productivity for biomass etc.

The Project presented is an attempt to establish a functional market mechanism in a context where only few functional examples of such mechanisms exist.

Contact: a.wilkes@cgiar.org

Giacomo Branca, FAO: Critical Aspects of Linking Mitigation finance to SLM and food Security

G. Branca (FAO) highlighted the importance of establishing links between mitigation efforts, land management and food security efforts. This linkage is important as climate change mitigation through agriculture requires to not only to look at technical aspect of mitigation but to consider as well the various socioeconomic linkages of agriculture in many countries. In doing so, the important role of agriculture towards food security issues and ecosystems services will become obvious. The figure below presents that argument and depicts the three important elements to be considered for sustainable soil management within the climate change context.



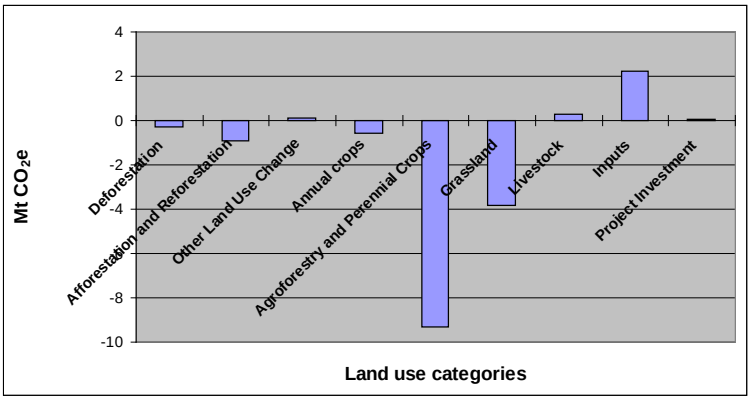
(R. Lal, *J. Plant Nutr. Soil Sci. 2010)*

This multiplicity of objectives renders carbon sequestration projects prone to compromises between the development objective and the climate mitigation objective. This challenge was demonstrated by a figure that is displayed on the title page of this report.

The presentation showed that the immediate costs of changing land use practices are very high while returns can only be realised in mid-term.

An example of a climate change mitigation project in Brazil was presented. The project applies a carbon balance tool called EX-ACT. The tool estimates C balances as a result of land use and management systems. (http://www.fao.org/tc/tcs/exact/en/). Preliminary results indicate that changes to more sustainable land use techniques, for example the establishment of agroforestry or perennial crop or grasslands on formerly degraded areas, do indeed trigger carbon sequestration as calculated by the EX-Act tool. A figure showing a part of the result of the Brazil project is shown below. Carbon is sequestered in numerous agricultural areas.

The C-balance of the SC Rural project



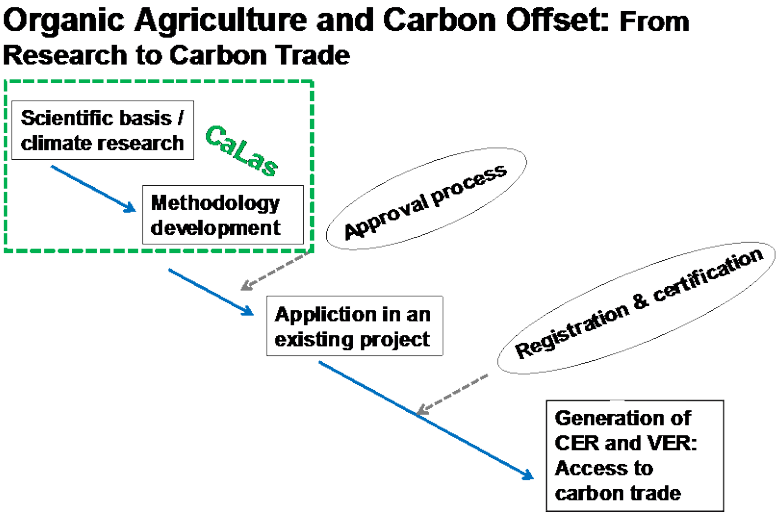
The presentation stated that the project promoted rural development/poverty reduction while also contributing to CC mitigation. The dilemma was however that CC mitigation benefits a much larger, almost global spectrum of actors while the project cost have to be generated at a local level. Another aspect is that the mitigation potential, given current carbon prices, is too low to finance projects like the one presented. The average mitigation potential was shown to be 0.92 tCO2e/ha/year. However, given the predicted increase in the offsetting prices of carbon in the international trading markets, the projected benefits for carbon sequestration may fluctuate widely.

Andreas Gattinger, FIBL: Carbon Credits for Sustainable Land Use Systems (CaLas)

The project focuses on establishing measurement systems for carbon mitigation in organic agriculture and the identification of co-benefits from organic agriculture.

The project is justified as there do not exist models to measure carbon in soils (one of the major problems identified in presentation 2) that are accepted by the international financial mechanism to be used for mitigation payment in agriculture. This is the reason why no agricultural soil carbon mitigation projects exist in the international mitigation finance mechanism.

The positioning of the project (in the dashed rectangular box) along a pathway towards generating accepted emission reduction certificates is shown in the figure below.



If an acceptable method or model to identify carbon sequestration in agricultural soils can be developed, the problem of baseline setting and the identification of additionality and leakage could be solved.

The presentation suggested however to focus the attention of rewarding systems for mitigation on 'low hanging fruits' as these are mitigation techniques in agriculture, which are already accepted with international mitigation mechanisms (for example: compost, avoidance of synthetic fertiliser, avoided burning, biomass and biogas).

Thomas Stadtmüller, Helvetas: Contribution of two land use related projects to climate change mitigation and adaptation

and:

Chris Morger, Intercooperation: List of agricultural and NRM-projects implemented by Intercooperation and their assumed potential of CO_2 sequestration

Thomas Stadtmüller presented a new lock at two former SDC projects in Latin America and reviewed their climate relevance. He suggested that f these projects did contribute to climate change mitigation. This has happened as a

result of protection and regenerating natural resources, which in turn has led to increased levels of soil organic contents. Yet, these apparent effects were not mentioned explicitly in the project documentation.

If this is so, then it appears that carbon sequestration is indeed one of the many elements that sustainable agricultural practices include, like regulation of soil fertility, regulation of the hydrological cycle and many others.

The following two tables show an extract of former projects of Intercooperation (IC) and Helvetas that was prepared for presentation at this Forum SLM. The lists contain professional judgements about the carbon sequestration potential of project activities. The assumed greenhouse gas (GHG) sequestration potential is indicated in the right column.

Country or region	Project content	Project purpose or goal	GHG sequestration potential (assumed)
Global (with emphasis on West Africa)	Introduction and development of organic cotton production systems	Introduction of sustainable low input production systems; creation of market access and income for local farmers	High
Burkina Faso, Mali, Benin	Identification, testing and dissemination of different organic production techniques adapted and responding to climate change	Improved income and food security through introduction of a diversified organic production system.	Medium
Ethiopia	Watershed rehabilitation and climate change adaptation	Rehabilitation of vegetation, soils and watersheds; improvement of hydrologic regimes and local livelihoods	Medium
Honduras	Introduction of agroforestry systems (cacao) and reforestation of pastures	Improve agricultural production systems and (explicitly) sequester CO2 using a REDD approach	High

Country / project name	Project content (objective)	Project purpose (expected results)	Assumed GHG sequestration potential
Peru / MASAL (Management of soil and water on slope)	Change in agricultural systems in the context of watershed	Increment of agricultural productivity through water and fertility improvement, as well as organisational strengthening	Medium sustainable land mgmt. decrease of degradation and decomposition of SOC
Andes / ECOBONA (social management of forest ecosystems)	Maintain forest cover for improved environmental services delivery	Innovation in income generating activities in order to decrease soil degradation and deforestation	High sustainable forest mgmt. decrease in deforestation
Bolivia / CONCERTAR (Governance and local economic	Sustainable management of natural resources with alliances between civil society, public and private sectors regional	Regional and inclusive planning for the sustainable management of the natural resources, with co-finances from state and private sector	?? sustainable NRM decrease in soil degradation and

Country / project name	Project content (objective)	Project purpose (expected results)	Assumed GHG sequestration potential
development)	development plans		decomposition
Ecuador / Cambio climático en el paramo	Change in water regime in the highlands of Ecuador	Analysis of the evolution in the cultivation patterns due to climate change ; influence on water availability for irrigation	Low concrete recommendations could be coming on best landuse practices

If future climate change sequestration is to be financed from private sources there is a need to better identify and quantify carbon sequestration effects in agriculture. The listing of past projects indicates that those effects are considerable. Yet the challenge is to establish effective and accepted soil carbon measurement systems.

So far the private sector does not invest in this area precisely because the identification and measurement methods are less developed. The two list extracts however show that carbon sequestration in agriculture is not a new benefit and that agriculture needs to be looked at in a more systemic manner. The list below highlight major challenges along this way.

Additionality: Projects in sustainable land management need to consider the additional effect their measures have in regard to greenhouse gas emission sequestration as compared to a non project situation

Leakage: Moving organic matter from one location to another does not necessarily increase global C-sequestration

Some compensation schemes are based on ‘models’ and not on ‘actuals’. There exists no accepted soil based carbon sequestration model as yet.

Projects do not usually monitor C- sequestration

Fragmentation of projects and small scale farm areas

Agricultural practices can be changed or modified from one year to the next as these systems tend to be very complex

Apart from small local compensation schemes for environmental services, mainly for water and watershed management, no C- compensation payment schemes exist as yet

3. Group work

Task of group 1: How can rewarding greenhouse gas mitigation promote sustainable land management?

- The group concluded that the present level of scientific certainty as regards sequestration measurements is low. This should, however not preclude progress in this area. The group suggested to act and rewards project that contribute to GHG mitigation even in the absence of scientific certainty. This will require the creation of supportive national and international institutional mechanisms. These do not exist at present.
- The group questioned the current level of institutional thinking that is oriented along administrative and scientific boundaries but which do not reflect true system boundaries
- The group questioned further whether the narrow approach of 'Payment for Environmental Services '(PES) approach is able to tackle the problem of measurability. As shown, climate change mitigation within the carbon cycle is an effect of much larger magnitude, i.e. the system boundaries are at global scale and very long term. The question, therefore remains whether a rather focussed rewarding system for greenhouse gas sequestration can capture the system boundaries that influence the sequestration process.

Task of group 2: Potential sources of finance for rewarding greenhouse gas mitigation via agricultural soils

- The forum focused on projects, like the China project, which attempt to develop systems to account for carbon sequestration and integrate these into international carbon trading schemes.
- The group realized that the setting of a baseline poses a major problem. Regular measurement of the C content in soils is, at present, expensive. The absence of scientifically established soil carbon modelling instruments is a considerable gap in establishing carbon sequestration tools in international financing systems. Therefore, projects like the one presented, seek to establish feasible methods.
- The group suggested to link sequestration systems in agriculture to already existing labels in this area. This avoids having to create complete new structures for future sequestration tools. Some of the known mechanisms to increase soil carbon content, for example in Organic Agriculture, are accepted knowledge that could be used to define sequestration regimes that are rewarded at international level.
- Sustainable agriculture that sequesters carbon in the soil, food security and the functionality of the soil ecosystem constitute additional benefits for which no payment regime exists so far. **Taken together, these**

benefits represent important sources of funds and opportunities for investment in the agricultural sector if acceptable payment regimes can be established.

- At present such payment systems for carbon sequestration in agriculture do not exist. The major reason is the uncertainty about the biophysical dynamics involved (as presented in the previous FORUM SLM) and the problem of measuring these dynamics.
- If it is agreed that some level of urgency exists, it could be argued, therefore that the application of the 'precautionary principle' is justified. In this case, however, public funding needs to available as the private sector will most probably not be available to an adequate level.

Conclusion and next steps

The Forum has generated a lively discussion on the topic of rewarding mechanisms for carbon sequestration in soils under agricultural management.

The theme is complex and can be divided into three levels of challenge:

1. The biophysical dynamics of gas emissions and sequestration in soils under agricultural use remains to be fully understood. This has been concluded as one of the results of the Forum SLM of August 2009.
2. Current methods of measurement of carbon sequestration in soils under various agricultural systems are complex and, therefore not practical under 'project' conditions. Due to the insufficient knowledge explained in para 1 above, models to calculate amounts of carbon sequestration are not reliable and are, therefore also difficult t be used under 'project' conditions.

Apart from the difficulty of bio-physical measurement, the second challenge is of economic and institutional nature. It is the difficulty to link 'producers' and 'consumers', i.e. those who produce carbon sequestration and those who consume the benefits. The challenge presents itself in very practical terms: Carbon is sequestered in soils because farmers or pastoralists change their management system. They incur directs risks and costs at local level. At the same time the benefits of carbon sequestration are enjoyed by a very large, dispersed and almost global group of carbon emitters. A financial scheme to reward carbon sequestration both actors needs to be create a negotiation platform for both actors.

What are possible solutions to overcome these problems?

1. There exist, at present already, an increasing number of products which are produced under certain labels, for example various organic labels. The land use methods under many of these labels are such, that sustainable soil management regimes are applied. Hence it can be assumed that carbon sequestration does take place although this is not an explicit objective of these labels. It seems, therefore possible that carbon sequestration in agricultural soils to mitigate climate change can be accommodated within existing agricultural labels. This would help soil management methods for carbon sequestration attaining prominence and ease their acceptance as mitigation tools. On the other hand the accommodation of carbon sequestration methods under labels may dilute the specific objective of mitigation towards climate change as label production aims more generally at sustainable production. Here climate change mitigation is only a collateral benefit.
2. The problem of measurability of sequestration remains central to the discussion. The Forum discussed options. A prominent element here was to consider desisting from the condition of proof. That is to apply the precautionary principle. The precautionary principle states that required policies and legal decisions, mainly in the environmental area, can be applied even in the absence of conclusive scientific proof but based on existing knowledge and experimental evidence. The principle is being

accepted by the judiciary in many countries and is being applied accordingly in numerous instances. The argument is that it is known that carbon sequestration takes place in, say organic agriculture. The carbon amounts sequestered could be calculated based on experimental evidence. This would form the basis of rewarding mechanisms.

3. Sustainable Land Management can provide multiple benefits. Policies and programmes are needed that promote SLM, thus delivering multiple global, national and local benefits. Rewarding carbon sequestration in agricultural soils can be a part of the solutions, but needs to be integrated in a broad set of measures that promote also the achievement of other important objectives, for instance food security, poverty alleviation, watershed management, disaster prevention and biodiversity conservation. This needs a broad and integrated approach, not only at the farm but also at the landscape level.

Concluding the Forum SLM, participants suggested that the organising committee should make efforts to synthesis the information generated in the two Fora into a paper that lists the current knowledge on carbon sequestration in agricultural soils and suggest policy options on how to best generate rewarding mechanisms for land users who support carbon sequestration by way of their land use regime.

Annex 1. Participants, Forum SLM, 24. June 2010

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